Nanoscale-Designed Ceramic Films

Applied Thin Films, Inc.(ATFI)
Evanston, IL

Sankar Sambasivan, Ph.D. Co-Founder, President, & CEO

Nanocommerce 2004 Chicago, IL October 5-7, 2004



About ATFI

- A private R&D company incorporated in 1998 based upon leading research at *Northwestern University*.
- Focusing on nanoscale-designed ceramic thin films for defense, energy, aerospace, automotive, and manufacturing.
- Four thin film platform technologies
- 12 Personnel (5 with advanced degrees). Housed in 8500 Sq ft of R&D thin film deposition and characterization facilities.
- Awarded Six US patents with several more pending
- Generated over \$5 million for R&D to date through grants and contracts



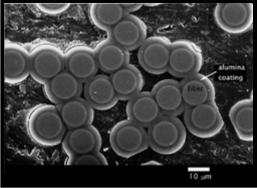
"Fenced-IP and Revenue-Ready"

Technology Portfolio

 Nanoengineered Thermal Barrier Coatings (TBCs)



- Conformal alumina films by Metal-organic chemical vapor infiltration (MOCVI)
- ECONOTM process Epitaxial Templating Technology for oxide growth

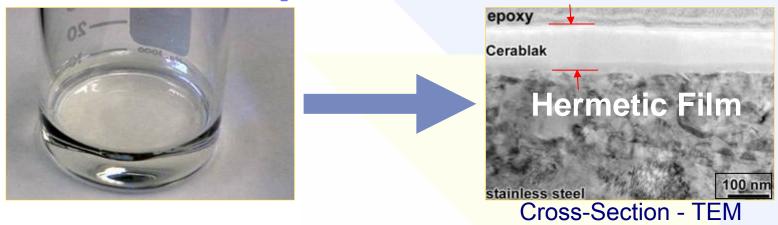






Introducing CerablakTM -

"Dip and Cure"



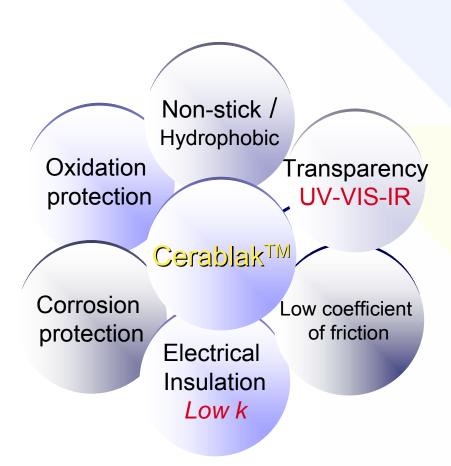
- Nanoscale-Designed Al-O-P polymeric precursor
- Al-rich aluminum phosphate "glass" stable above 1400°C
- Metal, Ceramic, Glass, and Polymer Substrate
- US Patents: 6,036,762 & 6,461,415



"One of the top ten new advanced materials in the market"

Frost & Sullivan (2003)

Processing, Properties, and Functionality

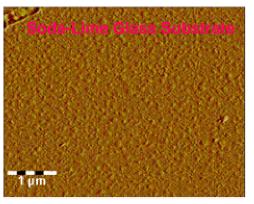


- Dip/Spray/Brush/Flow
- Brief cure @ 300-500°C, air (portable)
- One liter of precursor provides up to 1000
 Sq. ft. coverage
- Excellent adhesion
- Thin, flexible, hard, scratch-resistant
- Thermal cycling/ design tolerance

Low-Cost, easy-to-use, multifunctional ("Unlimited Possibilities")



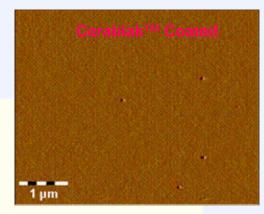
Nanoscale Surface Modification



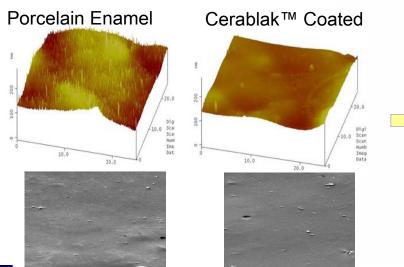
RMS roughness ~ 1 - 2 nm

Spin on Glass

30-100nm thick ~10X reduction in RMS



RMS roughness ~ 0.1 - 0.2 nm



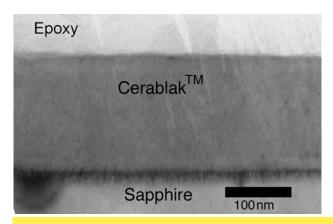




Durable Non-Stick

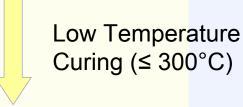


Thermal Stability & Barrier Properties

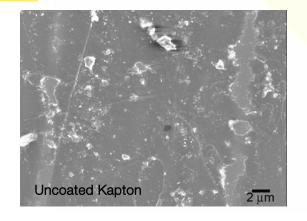


After 1000°C, 30 minutes, Air

Recent Development!!



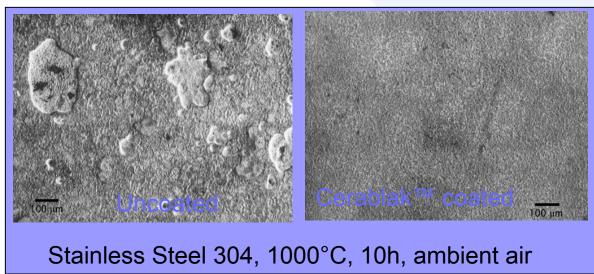
Cerablak™ on Kapton®





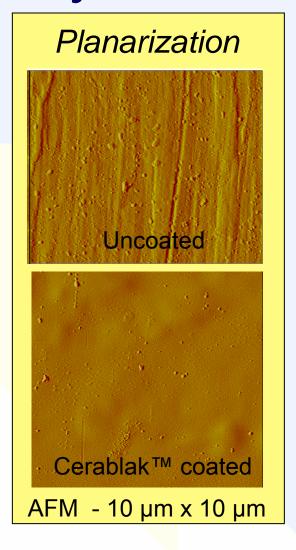


Cerablak™ on Metal/Alloy











Production & Scalability

- Stable, clear, low viscosity precursor
- Easy-to-Apply: Dip/Spray/Spin/Flow/Brush
- One liter produces ~1000 sq ft coverage
- Current material production sufficient to cover 40,000 sq ft per day



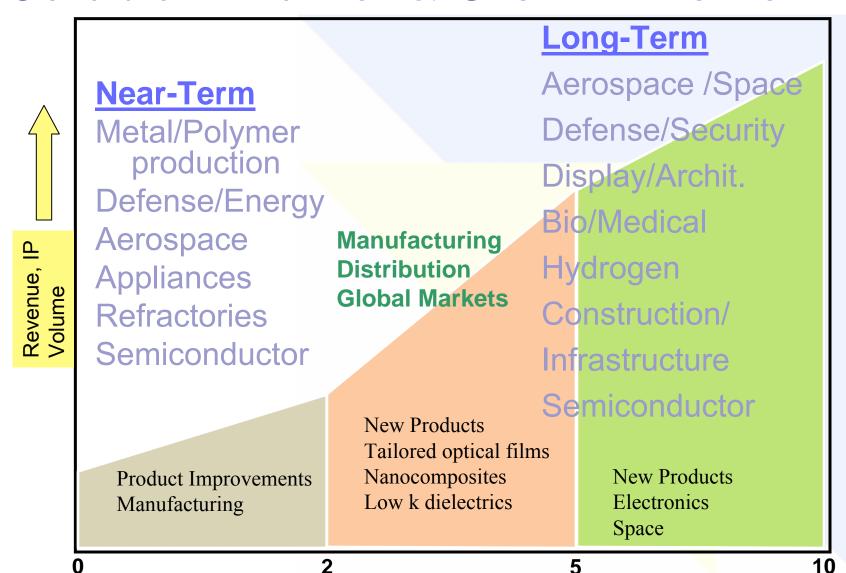




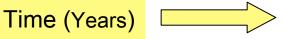
Application	Cerablak™ Performance Advantage
Display	 ❖Barrier film on glass or polymer substrate ❖Pin-hole free ❖Allows use of more inexpensive substrate
Biotechnology	❖Coatings for DNA microarrays❖Biocompatible implant coatingsNon-stick, corrosion resistant coatings for surgical probes
Solar Cells	❖Flexible dielectric films❖Moisture barrier❖Reel-to-Reel processing possible
Semiconductor	 ❖Planarization of substrates ❖Transparent coatings for photoblanks ❖Low κ dielectric
Aerospace	❖Turbine Coatings❖Thermal Protection❖Corrosion and oxidation protection
Manufacturing	 ❖Extend die/mold life with high temperature non-stick coating ❖Prevent oxidation and corrosion ❖Improve production efficiency and decrease downtime



Cerablak: Market & Growth Profile







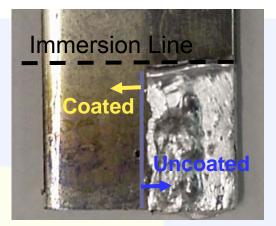
Sprayable Cerablak™

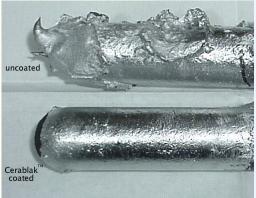
- Spray and Cure to yield ~100nm thick film on metal, glass, and ceramics
 - Semi-Permanent mold release and non-stick for metal casting/polymer production
 - □ Replace expensive alloys with Cerablak™ coated steel or other lower grade alloys
 - Seal porous ceramic (refractories, enamels) to extend life and/or limit gas diffusion
 - □ General corrosion protection
- Production capacity for raw material capable of 40K sq ft/day
- Strategic Partnership with Aerosol Manufacturer



Marketing Strategy: Al

- Primary Benefits -Lower downtimes, improve production efficiency
- □ Target end producer
 - Target primary casters
 - Capture 20% in 3 years projected revenue (\$6M)
- Ongoing projects with two leading Al producers



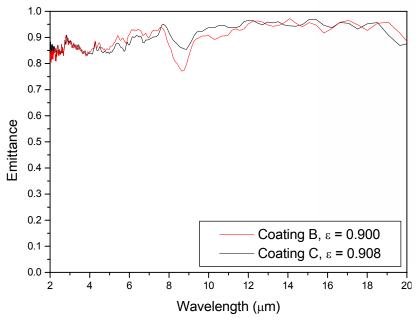




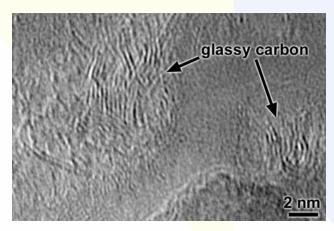


Cerablak™ Nanocomposites

- Next-Gen thermal protection systems for space & hypersonic vehicles (NASA SBIR)
- Furnace linings, heat exchangers, glass manufacturing
- Need emissivity >0.9 over 5-10 µm IR wavelengths







1200 °C, 50h, air



Summary

- Disruptive thin film product impacting multiple vertical markets
 - Achieved significant customer traction
 - □ Near-term focus on manufacturing & defense
 - □ Partner with *Display, Semiconductor, Biotech*
 - □ Projected revenue \$20M in three years
- Seeking strategic corporate partner
- Investment of \$4-6M (two years) needed for product development, facilities, marketing/sales, distribution, management team

